Goddard Memorial Park
Design

An Interactive Qualifying Project Report
Submitted to the Faculty of
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Degree of Bachelor of Science

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Abstract

This project involves the design of the Goddard Memorial Park. The park is to be a passive recreation area for the city of Worcester located near the Worcester Municipal Airport. The park is a memorial to Robert H. Goddard, a native of Worcester and a scientist who devoted his life to science.

The scope of the project includes researching documented accounts of successful parks, a land survey of the parcel of land, a proposed design for the park, a cut and fill estimate, and a total cost estimate. The design was completed in cooperation with the Robert H. Goddard Committee.

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Introduction

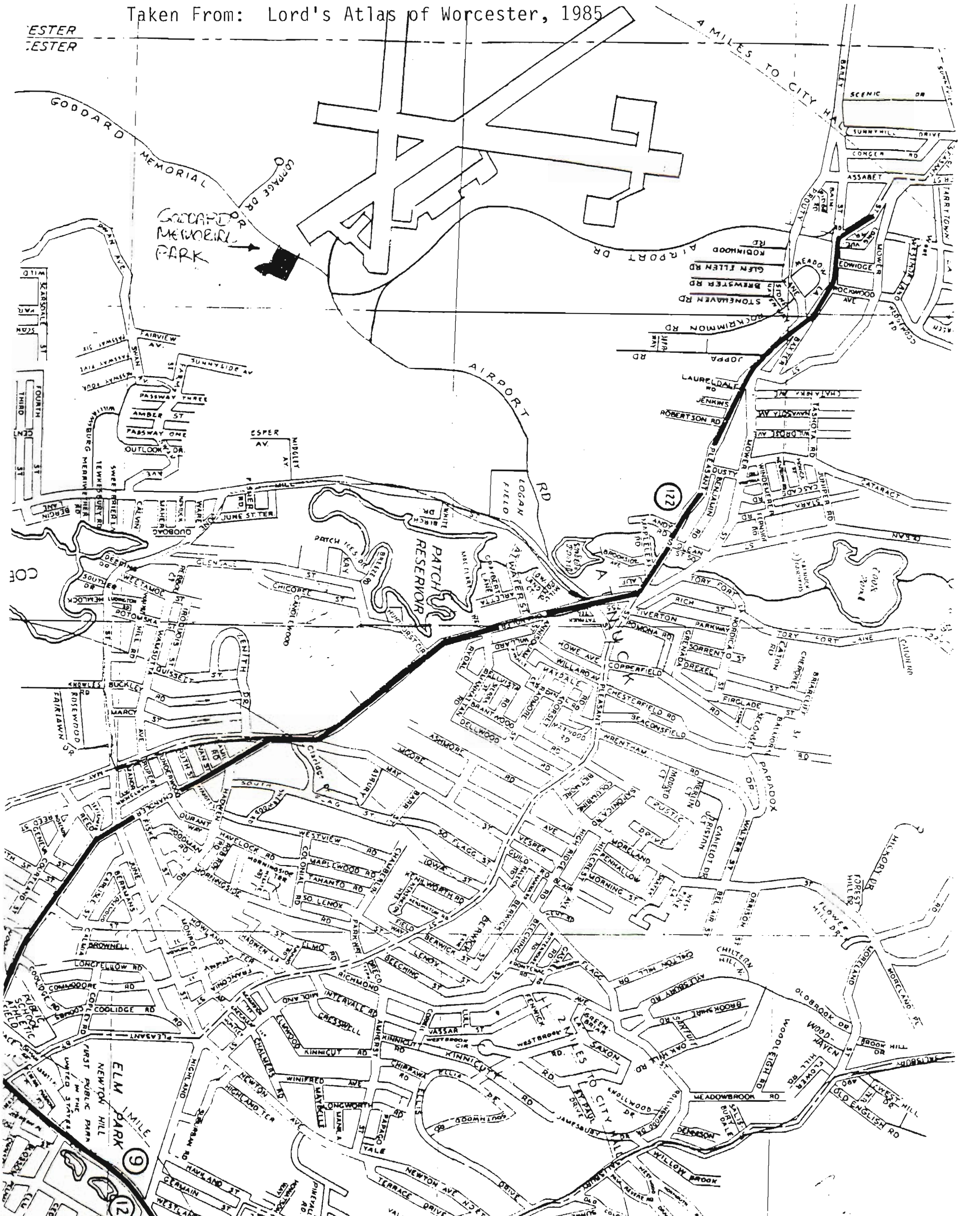
This project is a proposed design for a park in the City of Worcester, Massachusetts on a parcel of land on Goddard Memorial Drive, across from the Worcester Municipal Airport. Figure 1 shows a map of the location of the future park. This project was initiated at the request of the Robert H. Goddard Committee who's mission is to design and build a memorial park in honor of Dr. Goddard. The purpose of the park is to memorialize a great scientist and a native of Worcester, Dr. Robert Hutchings Goddard. Goddard is the often called the Father of Modern Rocketry for his great achievements in developing the liquid fueled rocket. Goddard is the man credited with the ideas that have propelled men to the moon. He was born and educated in Worcester Massachusetts.

The land set aside for the park is a five acre parcel directly at the end of the second runway at the Worcester Municipal Airport. The land is located on the crest of an immense hill with an elevation of nearly 1000ft. There is a roadway and two level areas with a ground cover of reclaimed asphalt. The upper level of the park area can be see in Figure 2. The picture was taken near the slope looking west towards the airport.

The view from the upper area is spectacular. From the site, you can view the entire city of Worcester along with the surrounding towns to the northeast. On a clear day you can see the Boston skyline over the hills in the distance. Figure 3 shows an example of the view overlooking the city of Worcester. The photo was taken facing east towards Boston.

Figure 1 Goddard Memorial Park Location

Taken From: Lord's Atlas of Worcester, 1985



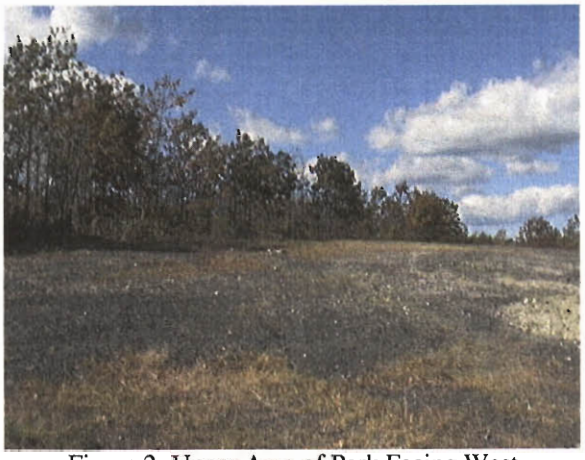


Figure 2- Upper Area of Park Facing West

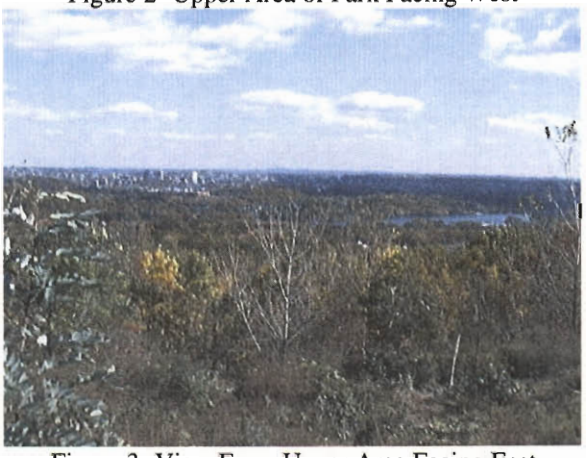


Figure 3- View From Upper Area Facing East

Another great feature of the land set aside for the park is that in includes connections to Worcester's hiking and biking rail system. People hiking on the trail will be able to stop and rest at the park. The trail connection to the park already exists and it

Figure 4- Trail Connection

is shown in figure 4. The picture in figure 4 was taken facing south. The upper level of the park is behind the photographer. The connection to the trail is about 50 feet ahead.

Along with the attractive features of the park there are several problems that will have to be dealt with in the design including the distance from downtown Worcester, the difficult landscape, and the dumping of garbage on the site.

The objectives of the park are to memorialize Goddard while giving the people of Worcester and Central Massachusetts a place to learn about the history of Worcester and escape the life of the city. The final design is based on considerations of successful parks, Massachusetts Building code, a survey of the park area, preliminary design ideas, suggestions from members of the Robert H. Goddard Committee, and a interview of members of Worcester's Parks and Recreation department.

Background

The information in this section is to provide a context for the design of the park. The park design was influenced by the information presented in this section. For the reader to have an appreciation for the design, it is helpful to read through this section which includes a biography of Robert Goddard, information about the parcel of land for the park, and a history of the Robert Goddard Memorial Park.

Dr. Robert Goddard

In designing a memorial park it is of paramount importance to have a feeling for the life of the person to whom the park will be memorialized. This is to ensure that the park, after being constructed, will have attributes to compliment the life of the person to whom the park is dedicated. The life of Robert Goddard was researched upon commencement of this project.

There is a great deal of information available about Robert Goddard and his work. This is a credit to Robert Goddard for his ability and discipline for documenting his designs and experiments. Information was available at the George C. Gordon Library at WPI as well as the Robert H. Goddard Library at Clark University. Clark University maintains a special collection for Goddard with over a hundred books, many being original documents of Goddard's. Also at Clark University, there are many of Goddard's original equipment used to design, build, and test his early rockets. Among the most valuable works aiding my research were the books This High Man, by Lehman Milton, and The Papers of Robert Goddard, a three volume set edited by Goddard's wife, Esther Goddard.

The Papers of Robert Goddard are three books full of information as directly written by Goddard. These papers include letters written to people supporting him, including Charles Lindberg and The Smithsonian. Also in these books are important journal entries and pages from Goddard's many notebooks. The books paint a picture of how intense Goddard was on developing his rocket. This feeling for the Father of Modern Rocketry is important in building a park to memorialize him.

Robert Hutchings Goddard was born in Worcester, Massachusetts on October 5, 1882 to Nahum and Fannie Louise Goddard. He was a bright child with an early passion for scientific things. When he was a young boy, Goddard realized his dream of sending something to the moon while he was trimming branches off a cherry tree behind his parents house.(1) He had read The War of the Worlds by H.G. Wells. "He later wrote a letter to Wells which said, "Aiming at the stars both literally and figuratively, is a problem to occupy generations, so that no matter how much progress one makes, there is always the thrill of just beginning.'"(2) It was at that young stage in Goddard's life when he devoted himself to developing what is now considered to be one of the most significant scientific developments of the 20th century.

Goddard was a very well educated person. He attended Worcester Polytechnic Institute following high school where he received a Bachelors of Science in 1908. He then continued his education at Clark University where he earned a Master of Arts in 1910 and a Doctor of Philosophy in 1911. Goddard was an instructor at WPI from 1908 to 1909. He then was an instructor at Clark from 1914-1915, promoted to Assistant Professor in 1915, and again to Professor in 1920. He continued as a Professor at Clark

until his retirement in 1943, though he spent much time on leave to further advance his work in rocketry.

The work at both WPI and Clark allowed Goddard to use the laboratories to begin working on his dream. He received small grants to fund this work, but not nearly enough to get to the moon. Goddard conducted small experiments and started making mathematical models of his rockets. He proved mathematically that it was indeed possible to get out of the Earth's atmosphere using thrust from a rocket. In 1914 Goddard obtained his first two patents from the United States patent office titled 'Rocket Device'. The patents were based on ideas Goddard had for solid fueled rockets.

In 1915 Goddard proved that thrust works inside a vacuum. This meant that rocket power would also work outside the confines of Earth's atmosphere. He proved this by setting a pistol with a blank in a vacuum. The pistol was set on an offset pivot, and when it was fired, the gun spun on the pivot, meaning the explosion caused thrust in a vacuum.

Goddard's first rockets were of the solid fuel type. Solid fueled rockets had been used before previously as weapons and fireworks. They essentially used gun powder and were similar in many ways to oversized guns. Goddard developed a device known as the de Laval nozzle for the solid fueled rocket. The major limitation of the solid fuel rockets was the inability to control the rate of the burn. The solid fuel could not be fed to the burner at a controlled rate because of it's physical nature. Goddard knew that a single explosion large enough to propel an object into space would never be suitable for man or machine because of the enormous intitial forces. Between 1917-1918 Goddard developed a weapon used in World War II known as the bazooka. The weapon was a

coincidental outcome of his research on solid fueled rockets. Goddard tested the rockets that became known as bazookas at Coes Reservoir in Worcester, which can be clearly seen in the view from the proposed site of the memorial park. The picture in Figure 5 shows the reservoir in the view.

Figure 5- Coes Reservoir

At about this time Goddard wrote a letter to the Smithsonian asking for a grant to continue his work on the rocket. The letter described how the rocket is important because it has the capability to get us to space.(3) "Goddard received his grant, but it came with nicknames that were embarrassing to him, such as moon man." (2) This grant allowed Goddard to get the materials he needed to start building the first liquid fueled rocket, a rocket that would burn liquid oxygen and gasoline steadily to create a continuous thrust.

About the same time of the bazooka and the Smithsonian grant, Goddard met his future wife, Esther Kisk, then a student at Clark. They were married on June 21, 1924.

Esther would always be an important part of Goddard's life, including journal writing and note keeping.

In the early 1920's Goddard had made a model of his rocket and conducted several experiments at Clark. While there was no flights, he was finding the lift force using instrumentation. This allowed Goddard to make adjustments to the Fuel Mix and the amount he would need to make a flight. Goddard's first flight took place on March 16, 1926 at his aunt's farm in Auburn Massachusetts. Goddard and his machinist, Henry Sachs were there to set up the test, and Esther took pictures. A schematic of Goddard's first rocket can be seen in Figure 6. His first rocket had the combustion chamber and the nozzle above the fuel tanks. The fuel tanks and their lines had to be insulated, and were done so in asbestos. This flight was a grand success though the flight was short. The event was historical, and there is now a monument at the site of Goddard's first launch.

Following the first launch there were several more at the same site in Auburn until 1930. The rockets grew larger and more complex as problems were recognized and fiixed. The combustion chamber was moved to the bottom of the rocket eliminating the need for the added weight of the insulation. The test stand grew taller to give more guidance to the rocket on it's departure. In 1929 Goddard had a rocket launch fail which caused a fire in a field in Auburn. This fire became big news in the papers because of the fancy contraption that had started it. People gave extra attention to the fire because of rumors of a moon rocket which had caused it. The attention that the fire generated was one of the best things that could have happened to Goddard's research. A well known pilot, Charles Lindberg, heard about Goddard's rocket and was very interested since he felt that the propeller had gone about as fast and high as it could. Charles Lindberg was a

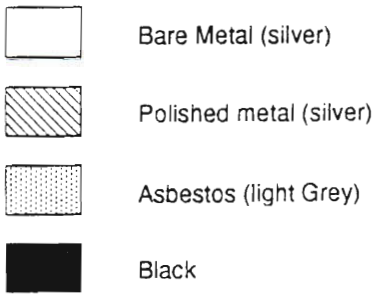
Figure 6 Goddard's Rocket

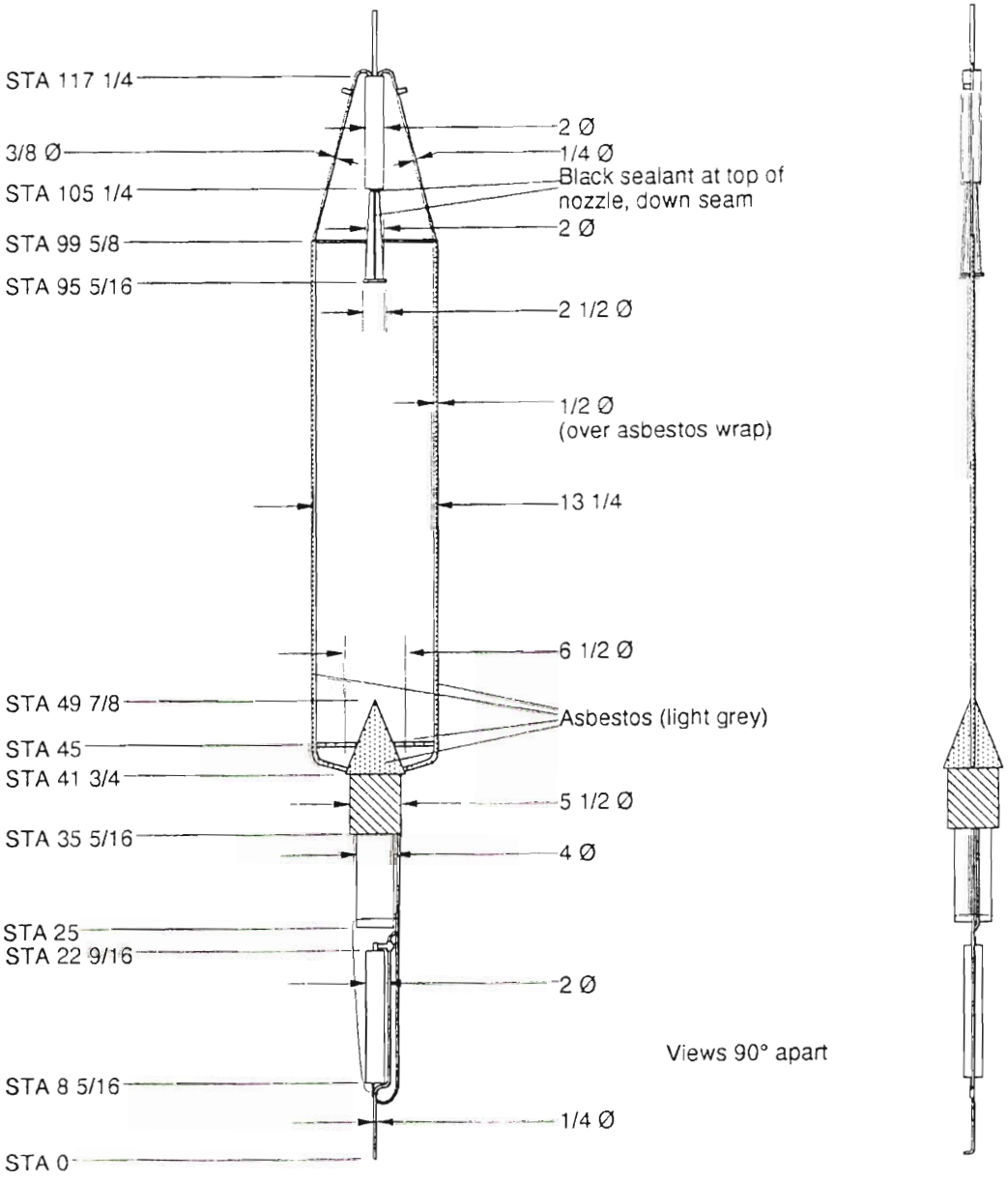
Rockets of the World, 1995

Goddard's Rocket of March 16, 1926

1/20 scale
Dimensions in inches

Sources:
Photo of rocket on launch stand, March 16, 1926.
Measurements of replica on display at National Air and Space Museum, Washington, DC.





help to Goddard because he was a well respected man in aeronautics and knew many important people and prospective financiers. Lindberg was able to convince Daniel Guggenhiem that Goddard's work was indeed important and very worth financing. Goddard wanted $100,000 for four years of research. Daniel Guggenhiem was a wealthy man who was notorious for supporting research in air travel. Guggenhiem awarded Goddard the grant at his son's, Harry, and Lindberg's suggestion. Goddard finally had the funding he needed to do the work he needed to work on rockets full time with a crew.

Goddard was told by the fire marshal that he could no longer continue his experiments in Auburn, so he and Esther moved to Roswell, New Mexico, 100 miles from White Sands, in 1930. He hired three men to help him with the work of building the rockets. He built an impressive launching stand about 30-40 feet tall with a great deal of instrumentation. Goddard kept in touch with Harry Guggenheim and his patent lawyer, Charles Hawley, while in Roswell. Following the end of the research grant Goddard and Esther moved back to Massachusetts in 1932. The death of Daniel Guggenheim and the depression made the Guggenheim advisory committee weary and the research grant was not renewed.(1) Goddard again received funding in 1934 and returned to Roswell.

In the mid 1930's Goddard's rockets were getting up to altitudes of 6,000ft contsistently. He had developed a gyroscopic stabilizer to steer the rocket which allowed for much more controlled flights. By 1934, Goddard had 26 U.S. patents for the liquid fueled rocket. At that time the German's were becoming interested in Goddard's work. They bought copies of his patents and brought them back to Germany to start their own work. Since the German's started with current technology from Goddard at the time, and they had funding from their government, they were soon building successful rockets

closely resembling those of Goddard's. During World War II, the Germans showed the U.S. Army that the work of Goddard was very useful. Goddard spent his later years doing work for the army, including work on rockets for airplanes.

Goddard died on August 10, 1945. It was the day after the second atomic bomb was dropped on Nagasaki. Robert Goddard had tremendous success working on his rockets. His work had a tremendous influence on modern space flight. His liquid fueled rockets were the beginning of using thrust as a propellant, the same basic principle upon which jets are designed and built on today.. In an interview with his wife after his death, she said, "This is perhaps what you call genius, but genius must then be capacity for hard work."(16)

After Goddard's death Harry Guggenheim and Esther Goddard worked hard to ensure Goddard was properly recognized for his work. They publishedd some of his work and received many more U.S. patents. Goddard received a total of over 200 U.S. patents for his work in rocketry. Harry and Esther also collected and published all of Goddard's notes and papers. These include 27 journals as well as many books based on letters and technical information written by Goddard. All of this information can be accessed today at Clark University.

In 1959 Goddard was awarded the Congressional medal. In 1961 the Goddard Space Flight Center was dedicated in the memory of Robert Goddard. In 1962, Esther was awarded 1 million dollars by the United States for Patent infringement. In 1978 a crater on Earth's moon was named after Goddard.

It is clear that Robert Hutchings Goddard is a special person. He devoted his life to science and the pursuit of knowledge and in the process changed the way the world

lives today. His creation and development of the liquid fueled rocket has enabled us to travel into space opening the doors to many of today's technologies from weather forecasting to cellular phones. Robert Goddard deserves the recognition in the city where he was born and realized his dream.

Robert H Goddard Committee

The Robert H. Goddard Committee was formed in early 1988 with the intention of honoring Robert and Esther Goddard. This group has met for the past 11 years and in that time they have celebrated many achievements. Those include a memorial to Goddard at the Worcester Municipal Airport, the dedication of Goddard Memorial Drive near the airport, informative signs entering Worcester, as well as a dedication plaque at the end of Goddard Memorial Drive.

Since it's formation the ultimate goal of the committee was to design and build a memorial park for Goddard. Late in 1989 the group was granted use of the parcel of land near the airport by the airport authority. Since then, the committee has been working on making the park a reality. A student group from WPI assisted the group with a design concept for the park in 1994. (4)

Today the Robert H. Goddard Committee has over 20 members including Ann Johnson of the Worcester Office of Planning and Community Development and Paula Buonomo of Representative Jim McGovern's office. Ann has been responsible for many similar projects for the City of Worcester and brings years of experience to the committee. Ann has contributed to the park in many ways including design ideas, integration with the City of Worcester, and access to survey maps. Paula Buonomo could help the committee by winning public support through her affiliation with Rep. McGovern's office.

Signs have been placed at the entrance to the site to aware residents of the possibility of the park being built. The remote location of the park limits the number of people who see the sign and public knowledge of the park has been low. The objective

of the committee is to involve the community in raising money for the park. Their plan is to engrave names of contributors into bricks used in the memorial circle.

The money needed to build the park will have to come from both public and private sources. There are grants available for new park construction but the funds are limited.

Existing Parcel Conditions

The Goddard Memorial Park is to be located on a 13.8. acre parcel of land located off Goddard Memorial Drive.(See Appendix II: Land Survey) The land is owned by the Worcester Municipal Airport as part of a restricted land use area. The area set aside for the park is located at the end of the runway which runs southeast, and is therefore restricted in it's use. There are also limitations on structures and lighting on the land. The limitations should not be a factor since the park will be passive recreational with no buildings or recreational structures. The park is located directly at the end of the runway it should not pose a significant nuisance to park users since the runway is not heavily used.

On the property there exists a roadway connecting two relatively flat areas to Goddard Memorial Drive. The road and the level areas both have a base material of reclaimed asphalt and other fill. The road is approximately 20 feet wide with a 8-10% grade. The elevation at the entrance from Goddard Memorial Drive is 925 feet above sea level and the highest elevation in the cleared area is 951 feet. The lower area is approximately 8,000 sq. ft. and the upper area 20,000 sq. ft. The larger, upper area is clearly more useful for the park.

The view from the upper area is spectacular. The City of Worcester is pleasently displayed below as well as many of the neighboring hills to the southeast. It is possible to see the City of Boston on a clear day. The view is a very special asset for the park and

will attract many visitors. Maintaining the view was a priority throughout the entire design process.

Another key asset of the park is the connections to the Worcester Trail Sytem. There are two existing trails which intersect with the Goddard Memorial Park. The area will be a fitting addition to existing recreational areas including Cascades Park, God's acre, and Parson's Cider Mill. Figure 7 shows a comparison of the park locations. The areas all are connected with each other with hiking trails. Parson's Cider Mill is a 33 acre area which includes two ponds. Cascades park is a 313 acre park which borders Holden and Paxton. The area is historic with numerous landmarks from the Native Americans.

As with any future construction sites there are concerns which will affect the design. The first is the two levels of area and the steep slope dividing them. The slope could be a potential safety hazard if not properly treated in the final design. Another concern is the poor soil conditions from a landscape point of view. A good portion of the area is covered with reclaimed asphalt used as fill. The porous fill will increase saturation of rainwater quickly. The combination of being a high elevation prone to wind and direct sun, and the accelerated saturation may cause burning of the proposed lawn and plants. The areas not covered with the fill have poor soil qualities with little or no organic topsoil. The entire area surrounding the park lacks organic soil allowing a diverse landscape. The existing plants are all small in size and hardy.

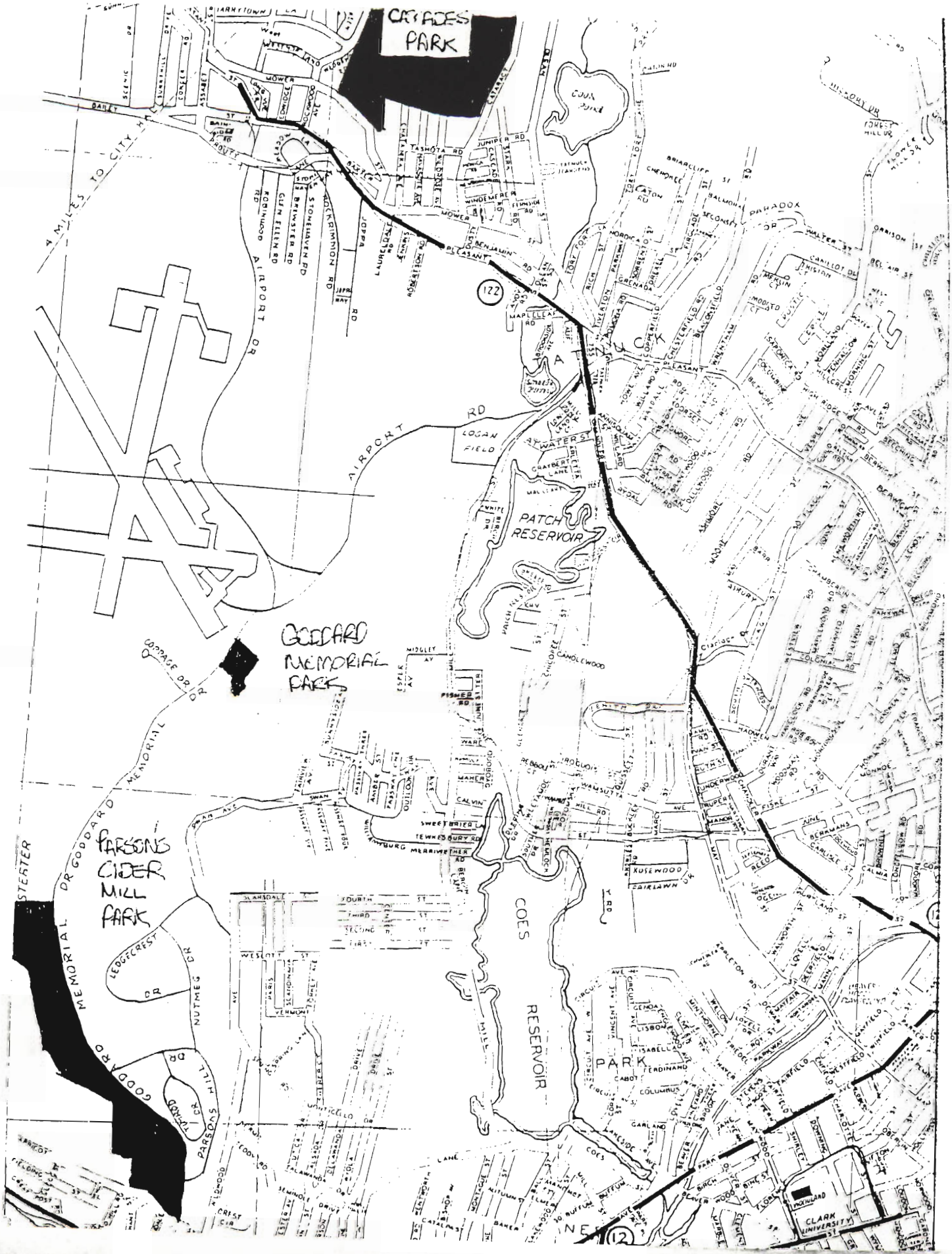
The concern that is perhaps the most difficult to overcome is the illegal trash dumping that has taken place and is likely to continue. The remote site is very attractive to people looking to dispose waste. At the site there is evidence of dumping of many

types of waste including household trash, construction debris, and bulky waste including appliances.

Despite the few difficulties, the area dedicated for Goddard Memorial Park is fitting. Being away from the city lights in the open area combined with the high elevation makes looking to the stars easier. The trail connections together with the view make the site a unique opportunity for the entire City of Worcester.

Figure 7 Parks Location Map

Taken Form: Lord's Atlas of Worcester, 1985



Park Design Research

Successful Parks:

It is important to understand the key features of a successful park before attempting to design one. There is a great variation in design and purpose of parks in many conditions. There are parks which are very successful with excellent attendance, maintenance, and enjoyment. There are also many parks which are very unsuccessful. The success of a park is not primarily based on location or attractions, but on thoughtful design and sufficient maintenance. The most important component of any successful park is always participation of the community, from design, to use and maintenance.

Other important features of a park are the land use, natural attributes and quality of design and construction. There are clever ways in which a designer can maximize a small area to attract large crowds. An example of this can be seen in Central Park and it's multiple level design, where trails, paths, and roads are all separated for a feel of seclusion.(5) A good landscape architect is clever with land use. The designer must know how the land is to be used and also must understand what people will look for and how they will react to different scenarios.

The first landscape architect, Frederick Law Olmsted, designed Central Park in New York City as well as thousands of other parks throughout the United States, including the WPI campus. Since Olmsted designed so many of the first parks, his style can be seen all over the country and is still copied today. He is known to use a landscape design of the English Romantic style with meandering paths and arched bridges.

Olmsted designed a natural beauty into his parks, using grass and plantings to give a full, natural look. (5)

Since Olmsted designed the first parks there has been a distinction between active and passive parks. The most extreme example of an active park is an amusement park. The consideration of what type of park is to be designed is important since the objectives of the people attending are different. Active parks usually attract people who are searching to be entertained. Passive parks attract those seeking time to relax and enjoy time in peace.

The first design consideration of any new park should be it's ultimate purpose. A park to be constructed with the intention of entertaining children is much different than the park to memorialize a great scientist. The most important step to the design is an initial survey, meaning observing natural features, and cultural features.(6) The natural features include vegetation, geology, hydrology, climate, and wildlife. The cultural features include transportation to park, community facilities nearby, utilities, uses, economics, and needs of the community.(6)

Several accounts of very successful parks around the country were researched. The most successful parks all have one thing in common, community involvement. The involvement that was so important in all the parks studied included design, use, and maintenance. The most notable park researched was the Boston's Post office Square Park. It is described as "The Perfect Park, in a perfect location, with a perfect design and having perfect maintenance." (6) The park is not large or secluded, only 1.7 acres in downtown Boston, but had an excellent land usage in the design and has excellent maintenance of its beauty. It is similar to the intended Goddard Memorial Park in that it

does not have any physical recreation facilities such as a playground. It a passive area for people to stop and break, with picnic areas and sitting benches. The most common user of the Boston park is people taking lunch breaks away from their workplace.

Vandalism:

Since Goddard Memorial Park is going to be located in the remote area and because of the evidence of illegal dumping, it is fitting to research vandalism including the causes and possible remedies to the problems. Vandalism has plagued many public facilities around the country. It is not an uncommon or poorly documented problem, yet there are few answers for solving the problems of vandalism. There are steps which a designer may take, however, to keep vandalism to a minimum.

For vandalism to be prevented, it must be defined what type of vandalism could occur and how it could affect the park. Vandals often pick areas which already look unowned or abandoned. Different equipment gets vandalized in different ways, and a good design plans for it.(6) The site of Goddard Memorial Park has attracted illegal dumping that is significant enough to cause concern. The dumping will perhaps be a persistent problem. Some specialists suggest that it may cease with the look of care being given to the park and a few other techniques such as lighting, a look of openness, and regular police patrol.(6)

An argument exists between providing trash receptacles or making parks carry out facilities. Some believe that trash receptacles invite people to through excess garbage in or nearby the container knowing someone will be by to remove it. Some designers feel trash receptacles are necessary in keeping littering of wrappers and other personal trash to a minimum.(7)

Land Use:

In an Urban park, land use is very important. Open space in a city is difficult to get for public use, so in the event that it happens, it is important for the design to use all the space as wisely as possible. Every component of the park must be rationally justified. Therefore, each component must have at least one identifiable purpose.(8) It also must be considered if the components use the areas best attributes, such as a lake, a good view, or an attractive landscape. One key point of park design that sums up the point is "major increases in productivity can result from minor design changes." (8)

Almost all sources for information about park design reinforce the necessity for clever design to attract and please different people. The understanding and sensitivity of peoples' needs is a skill that takes research and experience. Every component of a good park takes the users into consideration from parking lot design to stairway design to the amount of grassy areas. Parks may not have the structural concerns of a large building or the soils considerations of an earth dam, but are nonetheless difficult to create an effective design. The key difficulty in a park design is to keep the most important component of the park in mind, the people.

Procedure

The design of the park was an ongoing process over the period of four months. The first step taken was to obtain a survey of the parcel of land set aside for the park. It was important to know what area was available and the topography of the land in order to achieve the optimal layout for the final design.

To include input from others on what they would like to see in the park, close contact was kept with several members of the Robert H. Goddard Committee. People in the committee who were key in seeing this design project through were Ann Johnson, Colin Novick, Barbara Berka, and Mike Troiano. They were extremely helpful and had many suggestions for the final park design. An additional effort to get ideas and information from experienced people was an interview of key members of the Worcester Parks and Recreation Department.

Handicapped Accessibility was also taken into consideration for the design. Research of ADA requirements was completed to assure the park met the needs of the disabled.

Land Survey

To get a good background to base the design, a survey of the park area was conducted. Already available from a GIS map was a map including Goddard Memorial Drive, the parcel of land, the entrance road, and topographic features. The information from the GIS map was supplied by the Office of Planning and Community Development on disk in an AutoCad file.

The GIS map was from 1988 and was outdated because of the fill brought to the park site by the Worcester Department of Public Works. The survey conducted for this project primarily focused on the open areas where the fill was added, which is also the area where the park is to be built. The results of the updated survey were plotted over the past results and the topographic lines were appropriately changed. A plot of the survey results can be seen in Appendix I.

The blue lines are the property lines, the purple lines are the topographic lines, each representing a 2 foot change, and the green lines represent the outline of the open areas. The scale for the plot is shown on the drawing inside the title box.

Interview

To get a realistic idea of what to expect in the future for Goddard Memorial Park, an interview of Mike O'Brien and Joseph Gleason of the Worcester Parks and Recreation Department was conducted. Mike oversees operations of the department and Joe is a foreman. The purpose of the interview was to get input from people experienced with parks. Key information important in the interview included expected park use, vandalism, design ideas, and expected maintenance..

Mr. O'Brien and Mr. Gleason were very helpful in offering their experience. Mr. O'Brien stated that the park may get some maintenance such as mowing and trash removal by his crews. He added that he is unsure of maintenance at the park since the Worcester Memorial Airport still owned the land. Mr. O'Brien also gave some design suggestions that were helpful. He suggested that no lights be installed inside the park area, and if a light must be installed that it be as close to the road as possible. The idea is contrary to what most books suggest for design. Mr. O'Brien feels that lights actually attract vandalism and dumping. He also suggested no circulation road be constructed since the area would not be patrolled often, and the road circling the site would allow people to dump during the day at such a remote site. Mr. O'Brien reported an account of a man dumping at a busier park in Worcester, Green Hill Park, in the middle of the day, right in front of the maintenance building.

When Joe Gleason was asked what could be added to the park to reduce vandalism, he answered, "nothing." Mr. Gleason added that the best vandalism

protection, especially at such a remote site, is to make all the parts of the park easily repairable. He mentioned a few examples of components such as park benches. He said that a park bench should be made of steel with such a coating as to facilitate easy cleaning or repainting. He said if a park bench is to have wood slats that they be made easily replaceable and of a rugged and inexpensive wood since the slats will be carved and broken often. Mr. Gleason also noted that any graffiti or other vandalism be removed or repaired as quickly as possible to keep the act from becoming a competition.

An important suggestion that both men agreed upon was the material for the walkway. They felt that a brick walkway would be a maintenance nightmare and a vandals dream. Mr. Gleason stated that a brick removed by a vandal could "easily become a missle."

It was a benefit to hear the men's suggestions for the park. They are the ones who deal with the parks long after the designers have gone. Getting their suggestions assures that the future of the park is considered in the design.

Handicapped Accessibility

When building any public facility all users must be taken into consideration. In designing a park, building codes must be followed to meet the needs of people with disabilities. Building codes and regulations are carefully set to meet the needs of most people. Under ADA, Americans with Disabilities Act, Massachusetts has set building codes and regulations for new construction, additions, and remodeling.

Massachusetts code is divided into survey forms. Within each survey form are related sections with situations a designer may incur. With each section is information on the required design criteria, including federal code numbers that apply. Shown below is a list of survey forms which relate to the Goddard Memorial Park.

Survey Form 2: Accessible Routes
Survey Form 5: Walkways
Survey Form 6: Parking
Survey Form 7: Passenger Loading Zones
Survey Form 8: Ramps
Survey Form 35: Signage
Survey Form 48: Recreational Facilities

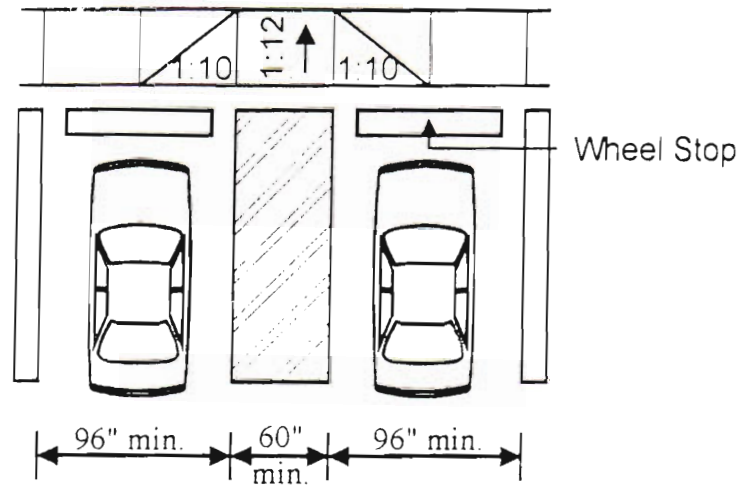
Most codes offer a description of the code or regulation and includes a diagram showing an example of what is required. An example of a survey form is #6, parking. It begins with a description of who is responsible for providing handicapped accessible parking. The second section includes a table of how many spaces should be allotted for handicapped based on how many spaces are in the parking area. The following sections describe how the spaces should be laid out. The aisle for handicap accessible spaces

must be 60 inches wide and at least 1 space of every 8 handicapped spaces must be van accessible with an aisle of 96 inches. There are several diagrams showing the designer methods of compliance in different situations. Figure 7 shows and example of a relevant diagram.

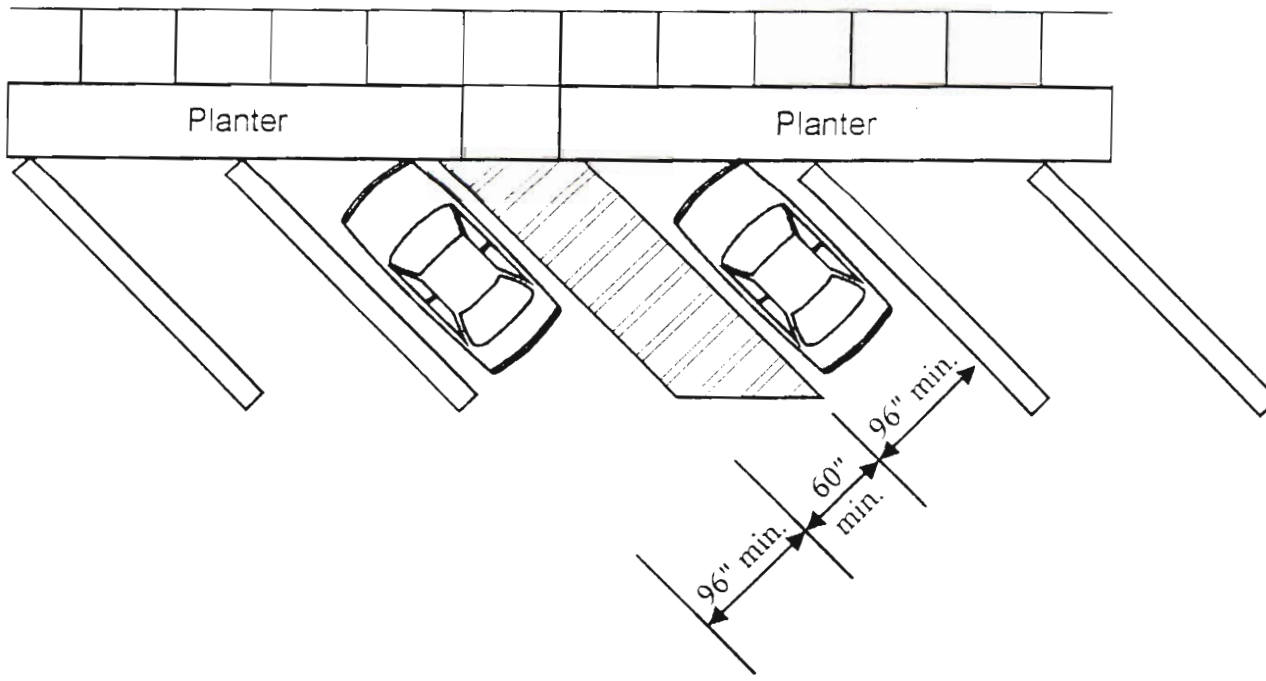
The handbook of codes and regulations is designed to be user friendly. It is helpful to be familiar with the handbook before deciding on a design, helping to eliminate feasibility problems that may occur if access is considered after the

Figure 8 Example Accessibility Diagram

Taken From: Americans with Disabilities Act, 1996



(a) Alternate Stalls



(b) Angled Parking

Design

The design of the park is presented in several AutoCad drawings with a description of the design shown in each. The first drawing is the overall park design showing the relative positions of the parking lot, the service road, the memorial circle, the suggested planting, and the proposed grassed area. The subsequent drawings are the details of several aspects of the design including the parking lot layout, memorial circle layout, entrance gates, specified guardrail design, and a detail of the granite rocket holder and solar system post to be used in the park.

The design of the park is explored in this project with a cut and fill calculation for the parking area and the sloped area in front of the lookout. To see where the excavating and filling are necessary it helps to look at the design in Appendix II and compare it with the survey drawing in Appendix I. The design changes the topography significantly to create a safe parking area and to create a more aesthetically pleasing hillside. The parking area requires significant excavation while the slope in front of the lookout will require a massive amount of fill in order to make it more gradual.

Included with the design of the park is a cost estimate for construction. The majority of the estimated cost information is based on previous prices given by specialty contractors on similar projects. The estimate is useful in deciding on the feasibility of the design presented.

Layout Drawing

The large layout drawing of the design is presented in Appendix II due to it's large size. The scale is larger than that used in the survey drawing in an attempt to capture as much detail as possible. Different aspects of the design are presented in different colors to ease interpretation.

The natural tree line is shown. Much of the tree line is presented in the design much as it exists today. The only area to require clearing is that for the parking. The remainder of the park was designed in the areas which are already clear.

The parking area is located close to Goddard Memorial Drive up grade from the existing entrance. The lot has an entrance and an exit to assure sufficient circulation, and is close to the road to reduce dumping and other illegal activity after hours. The service road and path exit the low side of the parking lot and follow the direction of the existing entrance road. A complete description of the parking area and service road are in the next section.

The circle seen on the design is the area dedicated to memorializing Robert Goddard. The memorial circle is detailed in the section titled Memorial Circle.

The design also shows that the lower area as seen in the survey plot in Appendix I is to be filled to create a more gradual slope. The gradual slope will take away from the area available for the park but will significantly add to the aesthetics for the person looking at the view. Since the park is not extensive in the use of land, the loss of the lower area is not an issue.

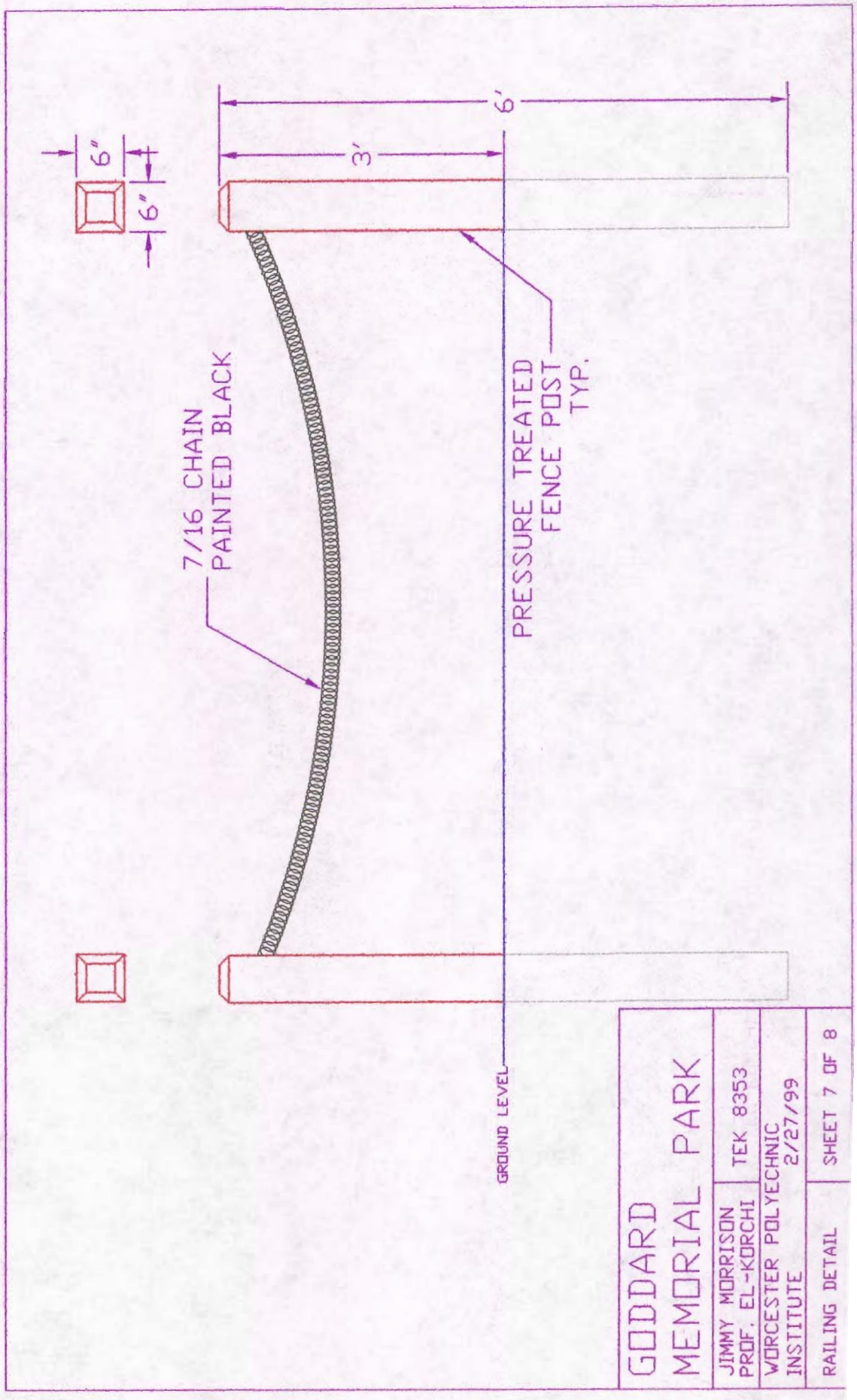
The outline of the grass area is shown in the design. The grass area is fairly large but was laid out to ease maintenance. The grass area gets long and thin to the south-east of the lot to include 200 ft. for the solar system that will be laid out without overly increasing the lawn area. The sides of the entrance road is not designed to have grass in an attempt to eliminate tedious trim work. The design shows a significant amount of grass, though trimming it can be done with large mowers. Calculated in the cost estimate is 385 cubic yards of screened topsoil for the area. Since the surface is currently reclaimed asphalt, a cover of 5" of soil was figured.

Also shown in the layout design of the park is the proposed layout of planting. Members of the Goddard Memorial Committee asked that Mountain Laurel, already present in the area, be added to give some added beauty to the park. The Mountain Laurel in the design is suggested to be mature to help ensure it's success in the tough environment at the park. To give some contrast to the landscape, White Pine trees were chosen for many areas. White Pines are very tough to the environment including soil conditions, wind, and cold. They have significant bulk to screen areas not wanted to be seen and to add a full green background. The slope created a difficult problem. The area needed a mass planting to prevent erosion yet needed to be low growing as to not block the view. Ground cover Junipers were chosen because they are extremely tough, require little maintenance, and are low growing.

The design shows proposed guardrails both in the parking area and in the park area itself. The guardrail in the parking area is primarily to keep automobiles out of the park and in the parking lot. The guardrail looking over the slope is to keep people from traversing down the slope. Though it will be filled and graded, the slope is still too

dangerous for there to be no guardrail. The guardrail was designed to be effective yet not unsightly. It consists of pressure treated 6" x 6" posts with painted black chain. A detail of a recommended guardrail is shown in Figure 9.

Figure 9 Guardrail Detail



Parking Lot, Service Road and Paths

The parking was kept near the road to keep automobiles out of the park area. Taking the property line into consideration the parking area was moved uphill from the position of the existing roadway. The parking area will need a substantial amount of excavating to keep the grade reasonable. The material excavated from the area can be used to fill the lower area as mentioned before. The parking is enough for 10 cars including one handicapped designated space. The detail of the layout of the parking area is shown as Figure 10. Note that the scale is printed in the title box of the drawing. The requirements for curb cuts and setback from the road as per the City of Worcester are met in the design of the lot.

The surfacing of the parking lot will be primarily a processed gravel with small areas being paved. The entrance and exit of the parking lot will each have a paved apron as shown in yellow in the detail. The handicapped space as well as the service road will be paved. Paving the road and the handicapped space allows a person on a wheelchair accessibility because it is a smooth and hard surface. The handicapped space will require a sign and striping.

An informational sign called a kiosk is to be located at the entrance to the service road from the parking area. The kiosk is to have information about the park as a whole. The kiosk is intended to match those currently in use around Worcester. Ann Johnson of the Worcester Office of Planning and Community Development who is also part of the

Figure 10 Parking Lot Detail

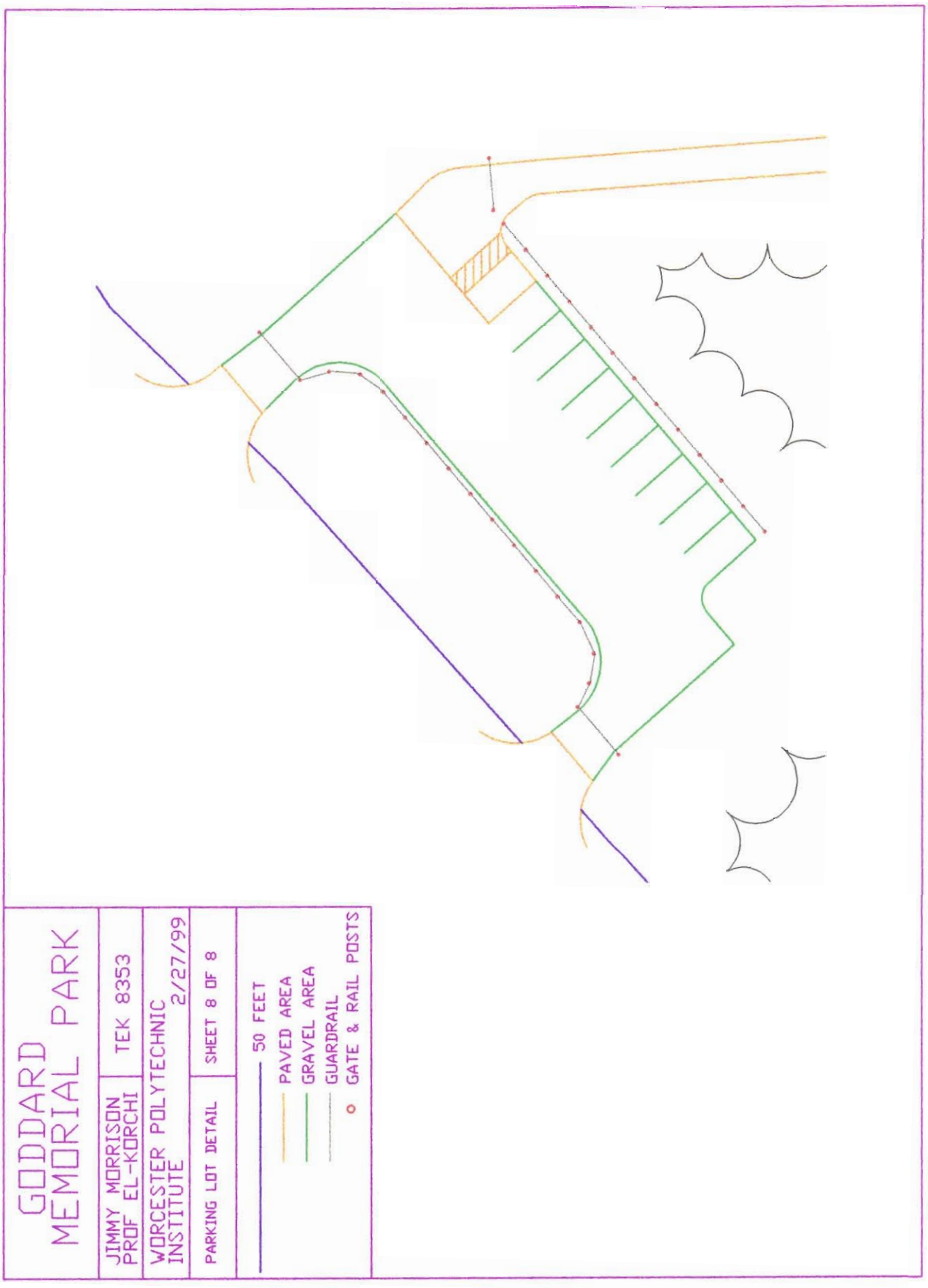
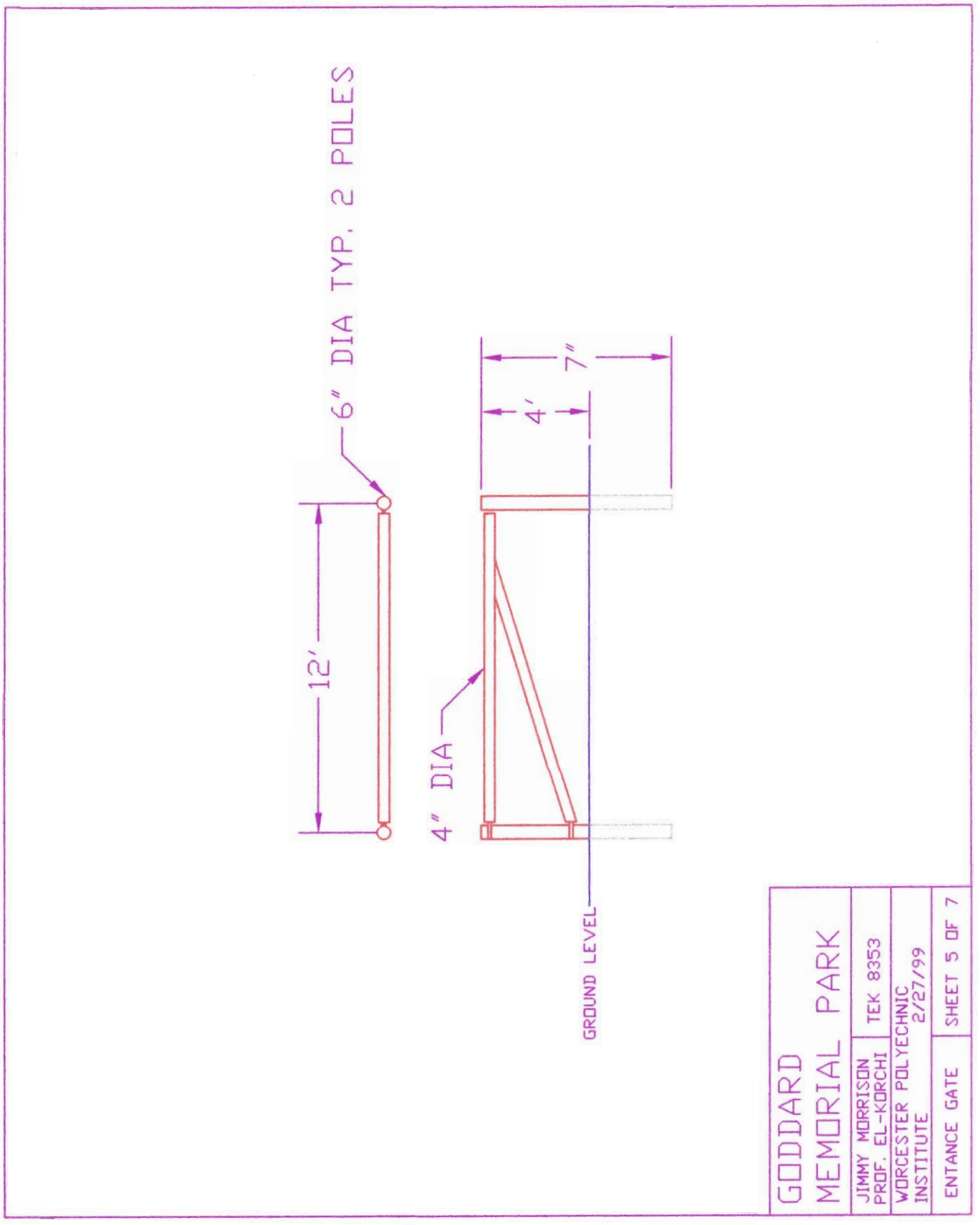


Figure 11 Service Gate Detail



Robert H. Goddard Committee chose the kiosks for the city and suggested they be used at the park. The bases are steel set into concrete. The sign itself is ceramic and is advertised as being virtually vandal proof. They are easily cleaned of graffiti and are not easily cracked. The kiosks seem to be a good choice for the remote park.

The pedestrian path to the park which is also the service road exits the parking lot and goes up the hill toward the park area. The service road is paved for handicapped accessibility and 8' wide to facilitate the needs of the maintenance trucks. The slope does not need to be 1/12 as specified for a ramp by ADA since it does not fall under the definition of a ramp. There is a gate at the entrance to the service road to prevent use by vehicles other than the Parks Department. There are also two gates at the entrance to the parking lot from the road. A detail of the design of the gates is shown in Figure 11.

The service road ends at the crest of the hill where the path to the memorial continues toward the memorial circle. The trail is paved but is narrower than the service road at 60". The width was chosen to meet ADA code for two way accessible routes. Branching from the path to the memorial is an additional stonedust path to connect the existing trail to the park. The purpose of the stonedust path is to reduce unsightly wear and tear on the grass from frequent use. The exisiting trail will remain in it's natural state. At the entrance to the trail is to be a second kiosk showing a map of the trails in the area.

Memorial Circle

The memorial circle is surfaced with brick. The trail splits into two brick walks with a width of 36". A detail of the memorial circle layout can be seen in Figure 12. There are park benches surrounding the circle for visitors to relax. To memorialize Goddard, there are two features included that are significant to Goddard's Life. In the center of the circle is one of ten granite posts located at the park. A schematic of a post is shown as Figure 13. The ten posts are to be located at the park to show the relative distances of the planets and the sun in our solar system. The post in the center of the memorial circle will signify the sun. Each planet will have a post with it's name engraved into it and will be a scaled distance from the sun in the center. The closest planet, Mercury, will be 2 ft from the sun. Pluto, the most distant planet, will be 200ft from the sun. The table below shows the relative distances of the planets in the scale to be used at the park.

Table 1: Relative Planet Distances from Sun

Planet	Distance(ft.)
Mercury	2
Venus	3.75
Earth	5
Mars	7.75
Jupiter	26
Saturn	48
Uranus	96
Neptune	152
Pluto	200

Another unique item to be placed in the memorial circle is a rocket that is now located at the maintenance facility at the Worcester Municipal Airport. The rocket was

Figure 12 Memorial Circle Detail

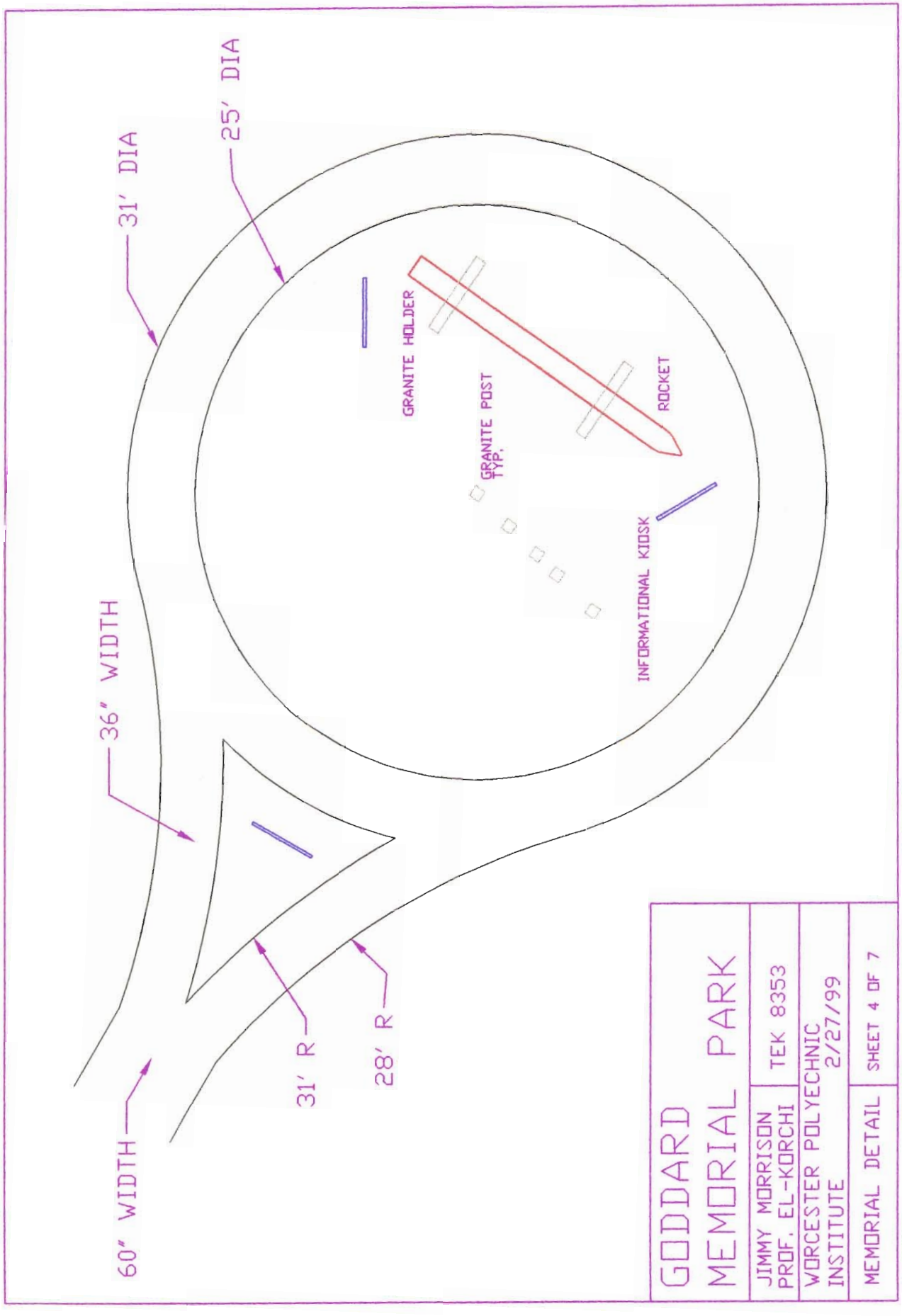
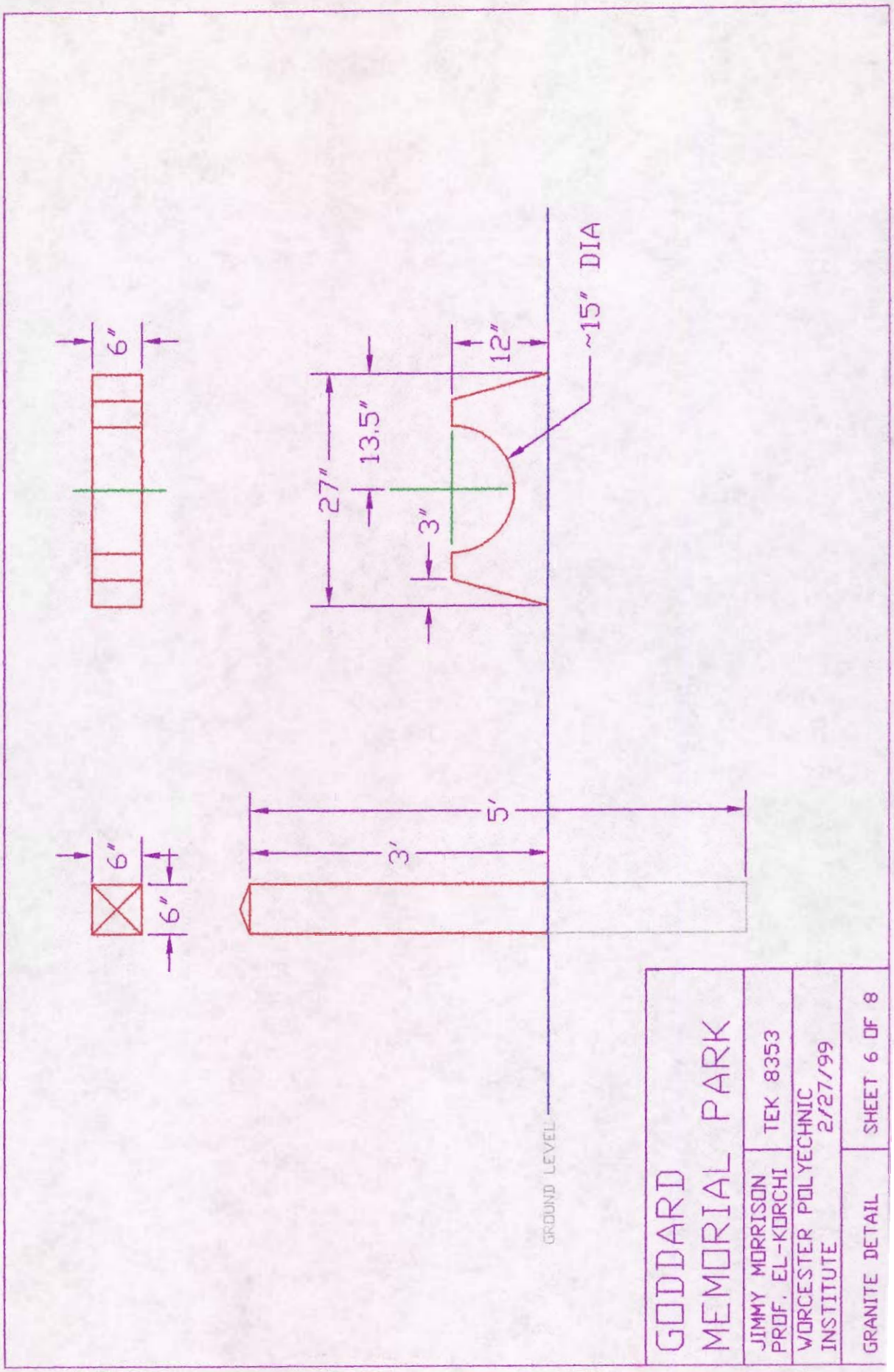


Figure 13 Granite Post & Rocket Holder Detail



most likely a missle that was built for the United States armed forces and was since disarmed. The rocket is approximately 15' long and 16" in diameter. It is free to be used for the park but the lead paint must be stripped off and must be repainted before it can be used. The rocket will be placed in granite holders placed on concrete footings. A detail of the granite holders is shown in Figure 13. The rocket will be a fitting addition to the memorial circle.

As seen in Figure 12, the memorial circle includes three informational kiosks. One sign will describe the life of Robert Goddard and another will describe the purpose and scale of the Solar System Posts. The third kiosk will have information about the view and the City of Worcester.

Cut & Fill Calculation

The calculation of the volume of earth to be excavated from the parking area and the area needed to be filled into the lower area are necessary to get a cost estimate. To estimate the volume of earth needed to be cut or filled the areas were divided into 10ft. by 10ft. areas and the depth of cut or fill estimated. A volume was then estimated for the area. The total volume for the entire cut and for the entire fill were calculated.

The result of the calculation of cut in the parking area was 1425 cubic yards. The area is about 15,000 sq. ft. and the deepest cut is toward the south east corner at approximately 5 ft. The north west corner and the entrances need no significant excavation however and so the average cut is about 2.5 feet.

The area to be filled is quite more massive than the cut and a large amount of clean fill will need to be hauled in. The total fill needed to produce the desired slope is about 4200 cubic yards. Since there is 1425 cubic yards in the parking area only an additional 2775 cubic yards will be needed. The area to be filled is about 27,500 sq. ft. and so the average depth of fill to be added is a little over 4 feet.

Cost Estimate

The cost of the major components of the park have been included to estimate the cost of the park as designed. The costs of earthmoving, landscaping, and paving are based on the area or volume of work to be completed. The prices are based on contractors prices for each task. The number for fill used over the slope is what is needed after the fill is added from the parking area. The price for excavation of the parking area includes moving the fill up the hill but does not include grading the area off.

The costs of the guardrail, granite posts and rocket base, benches, and gates are based on each being supplied and installed by the contractor. The costs of applicable permits was not included. Prices given are not necessarily for prevailing wage labor.

The total cost estimate for the project is $117,904.50. The two most expensive aspects of the park are the signs at $25,000.00 and the fill for the slope at $18,037.50. Table 2 below shows the breakdown of costs included in the estimate.

Table 2: Cost Breakdown

Activity	Estimated Cost
Excavating and Earthmoving:	
Excavation of parking area- $3.00/yard x 1425 yards	$4,187.00
Fill for slope area- $6.50/yard x 2775yards	$18,037.50
Screened Topsoil- $15.00/yard x 385 yards	$5,775.00
Grading- $0.12/sq. ft. x 68,000sq.ft.	$8,160.00
Landscaping:	
Raking and Hydroseeding- $0.16/sq. ft. x 21,000sq.ft.	$3,360.00
Supply & Plant Mountain Laurel- $125.00 ea. x 20	$2,500.00
Supply & Plant White Pine- $100.00 ea. x 15	$1,500.00
Supply & Plant Juniper- $45.00 ea. x 33	$1,485.00
Brick Walkway- $11.00/sq.ft. x 265sq.ft.	$2,915.00

Processed Gravel:	
1 ¼" Processed- $10.00/yard x 230 yards	$2,300.00
Paving:	
Preparation- $1.50 sq. ft. x 3500sq.ft.	$5,250.00
Paving- $1.00/sq. ft. x 3500sq.ft.	$3,500.00
Benches:	
Bench (installed w/ concrete pad)- $1000.00ea. x 5	$5000.00
Granite:	
Solar System Post (installed)- $1000.00ea.	
Rocket Base (installed w/ footings)- $2000.00ea. x 2	$4000.00
Security Gates:	
Gate (installed)- $1,200.00 x 3	$3,600.00
Guard Rails:	
Rail Posts (installed)- $45.00ea. x 70	$3,150.00
Chain (painted and installed)- $3.50 per foot x 650ft.	$2,275.00
Kiosk:	
Sign (installed) - $5000.00ea. x 5	$25,000.00
Rocket:	
Pickup, Deliver & Place- $500.00	$ 500.00
Remove Lead Paint & Repaint	$1,500.00
Handicapped Sign & Lines:	
Sign (installed)- $200.00	$ 200.00
Line Painting- $250.00	$ 250.00
Total Estimated Cost as Designed	$117,904.50

Conclusion

The design presented includes many of the basic parameters needed for the construction of the park. The topographic survey was needed for any ideas to be based on and for feasibility decisions to be made. The design details most aspects of the park including the general layout, parking lot, service road, trail connection, memorial to Goddard, and guardrails. The design should provide the Goddard Memorial Committee with enough information to proceed on to getting permits and approvals and to seek out funding.

If constructed, the park will be a great place for residents of Worcester to get away from the busy life below. While there they will enjoy a peaceful setting memorializing a special man that any resident of Worcester should know and be proud of. The rocket and the solar system are perfect symbols of the dream that fueled Goddard's desire.

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Appendix I: Land Survey Drawing

Project contains oversize
materials that could not be digitized

Original may be viewed at Gordon Library

IQP/MQP SCANNING PROJECT